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Inspection of Coated Subsea piping and risers

Riccardo Scottini Herman J. Quakkelsteijn
Applus RTD, Delftweg 144 - 3046 NC Rotterdam
P.O. Box 10065 - 3004 AB Rotterdam, The Netherlands
riccardo.scottini@applusrtd.com, herman.quakkelsteijn@applusrtd.com

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ABSTRACT Corrosion of Offshore installation is a major problem as they age and require replacement, which cost billions. Colapsing of these structures may costs lives and much money, therefore their monitoring and screening is a priority for maintenance management which may allocate the available budget just where is needed to assure the structure integrity and safety. Monitoring and screening of Offshore structure on the deck but also riser and subsea piping is surely cost-effective with RTD-INCOTEST, a Pulsed Eddy Current inspection technology to detect average remaining wall thickness of corroded low alloyed carbon steel structures through corrosion scaling, paint, coating, concrete.

INTRODUCTION Optimisation of maintenance of offshore installations is a key word and it is amazing to find out that simple solutions are often overlooked. Advanced Non Destructive Testing (NDT) technologies are available for a long time, but people are afraid to use them due to lack of knowledge or because of strong relation with local suppliers. Maintenance activities are commonly supported by UT an inspection method, which requires expensive cleaning activities. RTD has the solution: RTD-INCOTEST. This is a pulsed Eddy Current inspection technology which is a cost-effective alternative to traditional NDT inspection approach both above and below water: it is fast, it guarantees high production rate, it is suitable for RBI and Integrity Inspection, it is not affected by fouling and marine growth, and therefore no expensive cleaning is needed. It does not need any contact with the object to be inspected, it may inspect through paint, coating and concrete. In all situation RTD-INCOTEST will be time and cost saving up to 50% and will support the optimisation of Steel Sheet Piling and Bridge Structures maintenance with screening and identifying the areas and objects of interest.

OFFSHORE INSTALLATION, RISERS AND SUBSEA PIPELINES Monitoring and screening the deterioration and degradation of these structures is essential to assure their integrity, safety and availability which have surely a big economical impact on the all society.

Corrosion is an inevitable process which may be only reduced by using appropriate materials during the engineering and designing stage and by applying protection systems such as paint and coating, and cathodic protections to passivate the submerged structure parts.

Although corrosion is inevitable, its costs can be drastically reduced through an efficient maintenance management. Monitoring and screening are crucial activities for the structure degradation rate extimation, to assure the structure integrity and safety during operation and use. These activities will lead to the optimisation of the maintenance and will contribute to a continuos availability of the structures without unexpected breakdown which will cause unschedule interuption and in some cases serious economical damage.

Optimisation of maintenance is therefore a key word and it is amazing to find out that simple solutions are often overlooked. Advanced Non Destructive Testing (NDT) technologies are available for a long time, but people are afraid to use them due to lack of knowledge or because of strong relation with local suppliers. Maintenance activities are commonly supported by UT inspection methods, which require expensive cleaning activities. RTD has the solution: RTD-INCOTEST.

RTD-INCOTEST RTD-INCOTEST is an acronym for INsulated COmponent TESTing and it was originally designed and developed for corrosion detection under insulation on objects made of low alloyed carbon steel. RTD-INCOTEST is a Pulsed Eddy Current inspection technology which is a cost-effective alternative to traditional NDT inspection approach both above and below water: it is fast, it guarantees high production rate, it is suitable for RBI and Integrity Inspection, it is not affected by fouling and marine growth, and therefore no expensive cleaning is needed. It does not need any contact with the object to be inspected, it may inspect through paint, coating and concrete.

Fig. 1 RTD-INCOTEST through marine growth

Fig. 2 RTD-INCOTEST on riser with diver

Fig. 3 RTD-INCOTEST on riser with upsailer

(1) The system RTD-INCOTEST is battery operated and consists of a ruggedized notebook, a

pulsing receiving electronic unit, sensors, connection cables, two battery packs and a battery charger unit and it measures

the average remaining wall thickness of the object area under investigation.

Fig. 4 RTD-INCOTEST system

(2) Working Principe RTD-INCOTEST system measures the decay time of the eddy current induced in the object under examination. This eddy current is induced in the material by means of a DC current circulating through the sending coil circuitry of the RTD-INCOTEST sensor. This DC current generates a magnetic field that takes a while before getting uniform and stable. The magnetic field lines generated are closed lines and move through the insulation and the ferromagnetic object under examination. At the moment the current is cut off, the sending coil stops generating the magnetic field. During this transient, Eddy Current is induced in the ferromagnetic object under examination. This Eddy Current migrates through the object wall and rapidly extinguish when it reaches the opposite object side. Eddy current is a circulating current and it generates during its decay a variable magnetic field. Its field lines move through the sensor receiving coils inducing a current. The RTD-INCOTEST system measures the resulting voltage. This voltage is function of the object thickness and of the material electromagnetic properties.

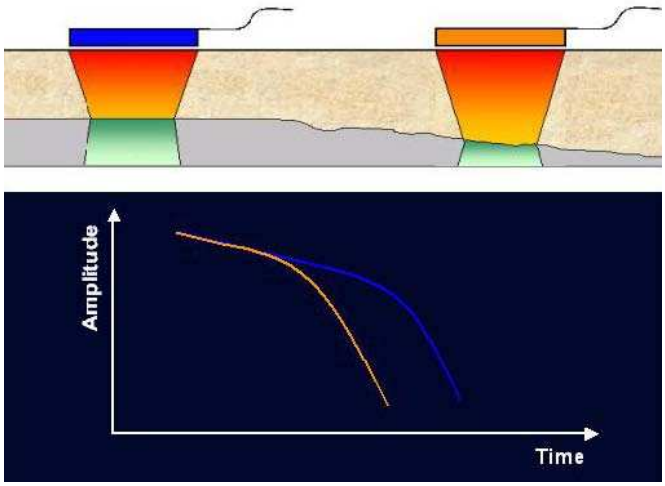


Fig. 5 RTD-INCOTEST signal, shorter signal on corroded area

The measured signal is presented in a logarithmic graphic: the horizontal axis represents the time

in milliseconds (ms) and the vertical one the measured signal amplitude (μV). Characteristic of this signal is the presence of a bending point that indicates the induced Eddy Current decay time. At this time the Eddy Current reached the opposite object side and rapidly disappears (signal drop after bending point). This time is called TAU and it is function of the material magnetic permeability, of the material electrical conductivity and of the square of the object average thickness in the footprint area: $\tau = \mu\sigma d^2$.

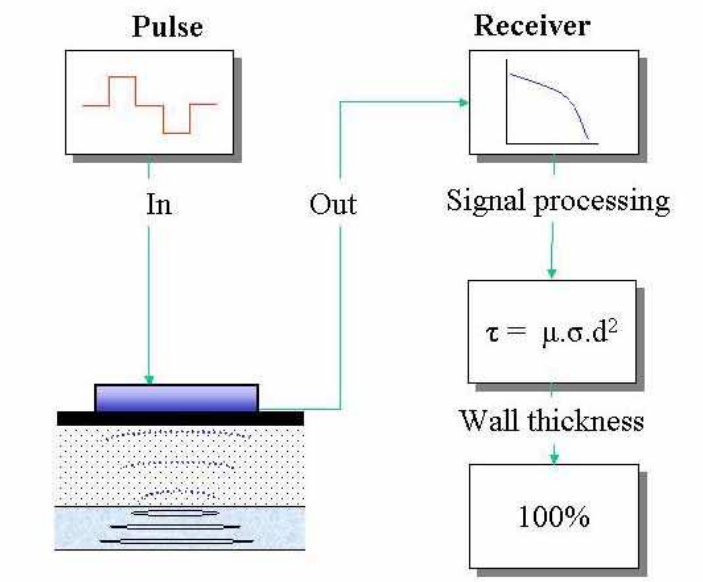


Fig. 6 RTD-INCOTEST Pulse-Receiver schematic

(3) Detection RTD-INCOTEST is designed for generalised corrosion detection and it will not perform with localised

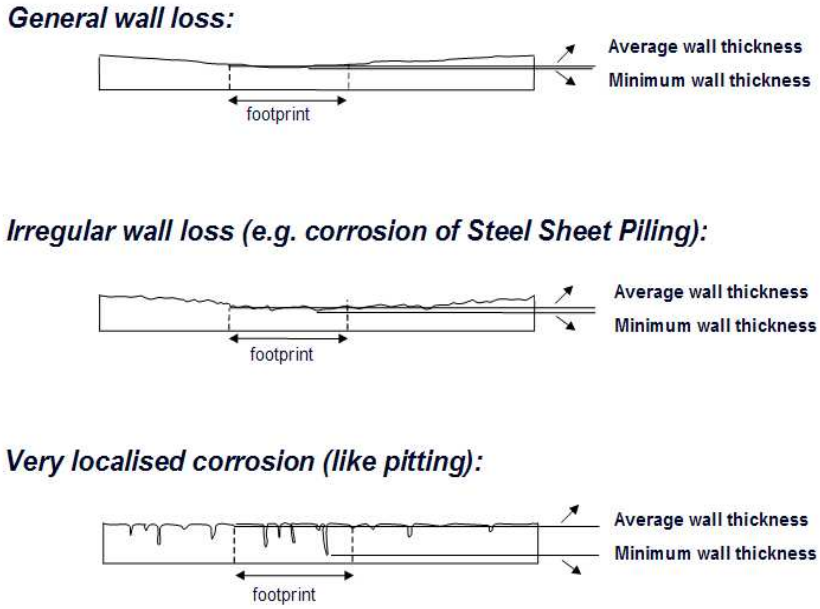


Fig. 9 RTD-INCOTEST detection A defect to be detected must have at least an extension of 1/3

of the footprint area and a volume reduction

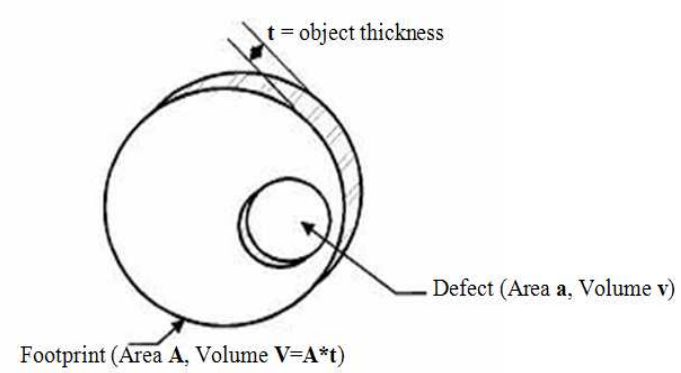


Fig. 7 Defect detection within footprint

The footprint area is function of the selected RTD-INCOTEST sensor and of the measuring geometry situation: object wall thickness, insulation thickness and shape. The sensor footprint diameter increases

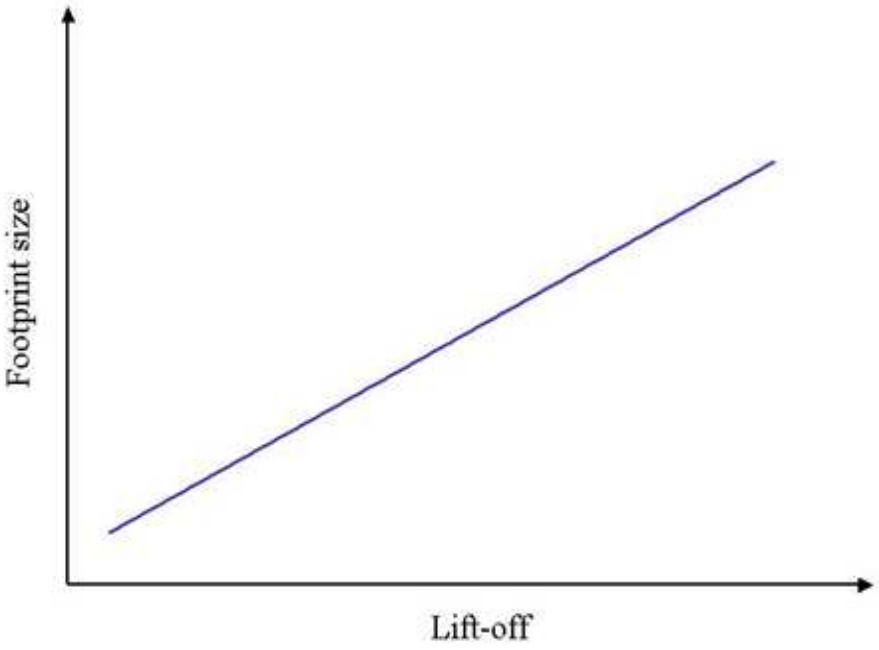
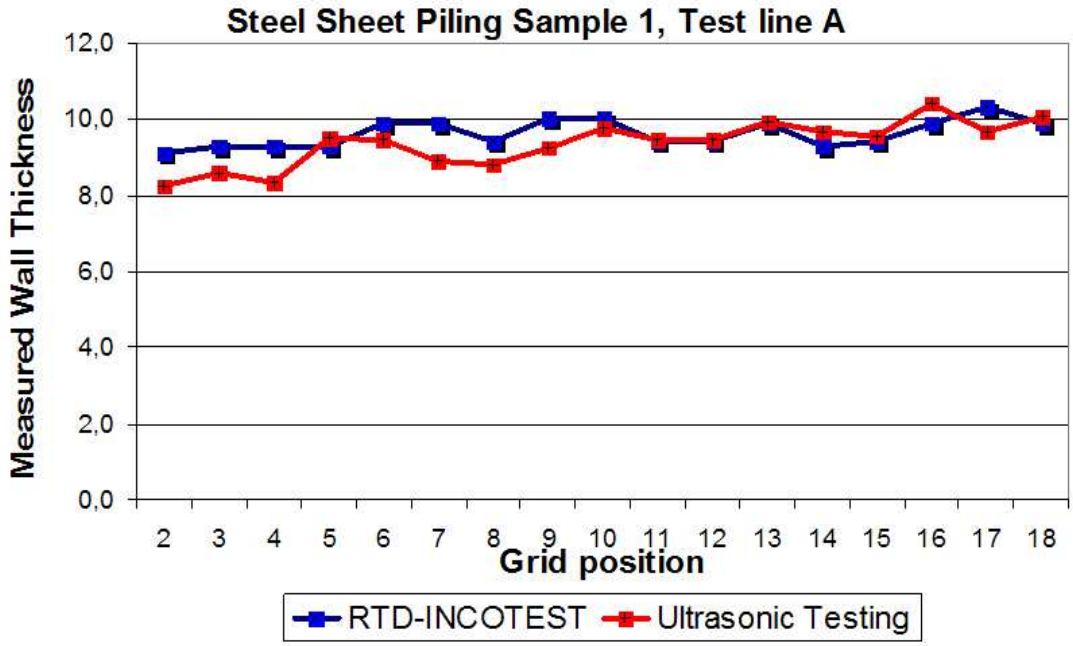


Fig. 8 Footprint size versus Lift-off

(4) RTD-INCOTEST versus Ultrasonic In 1999 RTD performed an inspection project for De Rijkwaterstaat, the Dutch ministry for transport and waterways with as objective the comparison of RTD-INCOTEST with Ultrasonic measurement. For this project some corroded steel sheet piling samples were inspected according to a 50mm grid with ultrasonic testing and with RTD-INCOTEST. The RTD-INCOTEST footprint was about 60mm in diameter and the Ultrasonic value was calculated by averaging 4 UT spot on the footprint area for each grid position.

Fig. 9 Steel sheet piling samples

The measurement showed a deviation up to 1mm and an accuracy of both inspection techniques within 1mm.

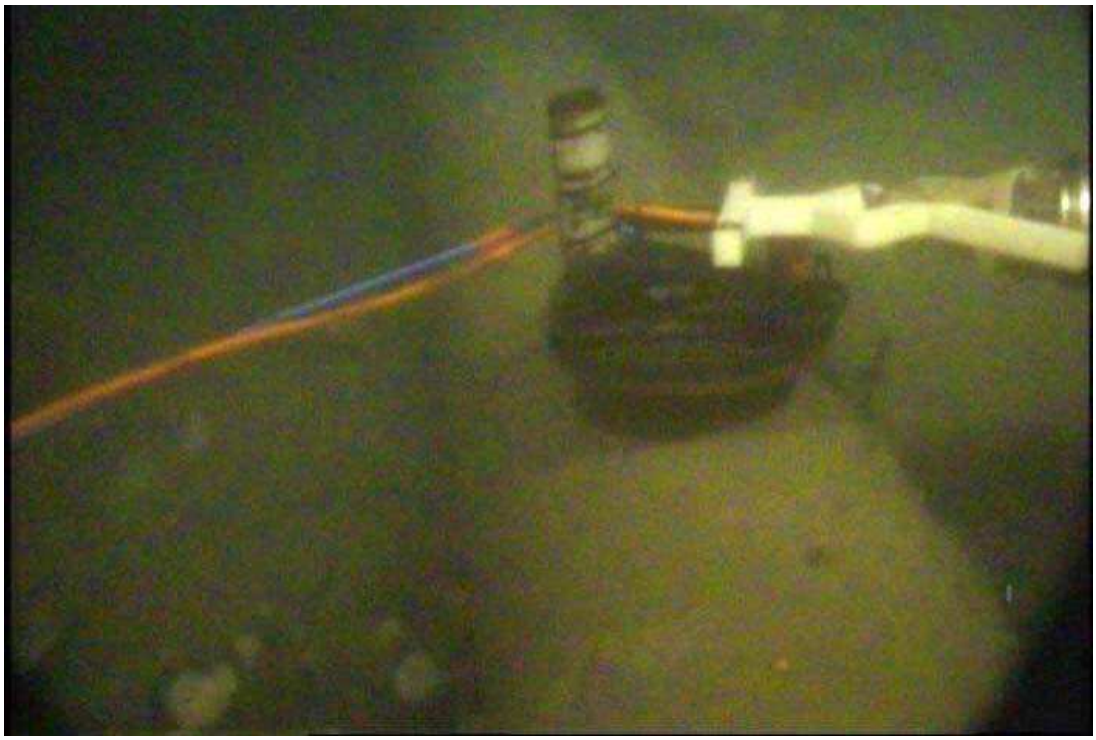


During this testing RTD-INCOTEST showed a higher production rate not only because to perform a measurement no special cleaning is needed but also because on corroded surfaces is quite difficult to perform a good UT reading. Further RTD-INCOTEST could measure through lamination and double plate, which is physically not possible for UT technique which “signal” stops at the first interface. Ultrasonic showed the advantage of a local wall thickness value, while RTD-INCOTEST gives the average on the footprint, and less geometrical influences.

(5) RTD-INCOTEST subsea operation today In the last year we got more and more request for inspection of not pig-able sealines mostly down to 150m where we may operate with our 200m probe cable and in some situation with divers. Due to deep sea growing market we are presently evaluating a project to reach a depth of 2000m below sea level.

Fig. 11 RTD-INCOTEST Subsea probe designed for operation at -2000m (Test pressure 250Bar)

Deep sea operation will require ROV which will not only have to place the probe but also take the measurement electronic on board, which will be operated from the inspector from the support vessel.



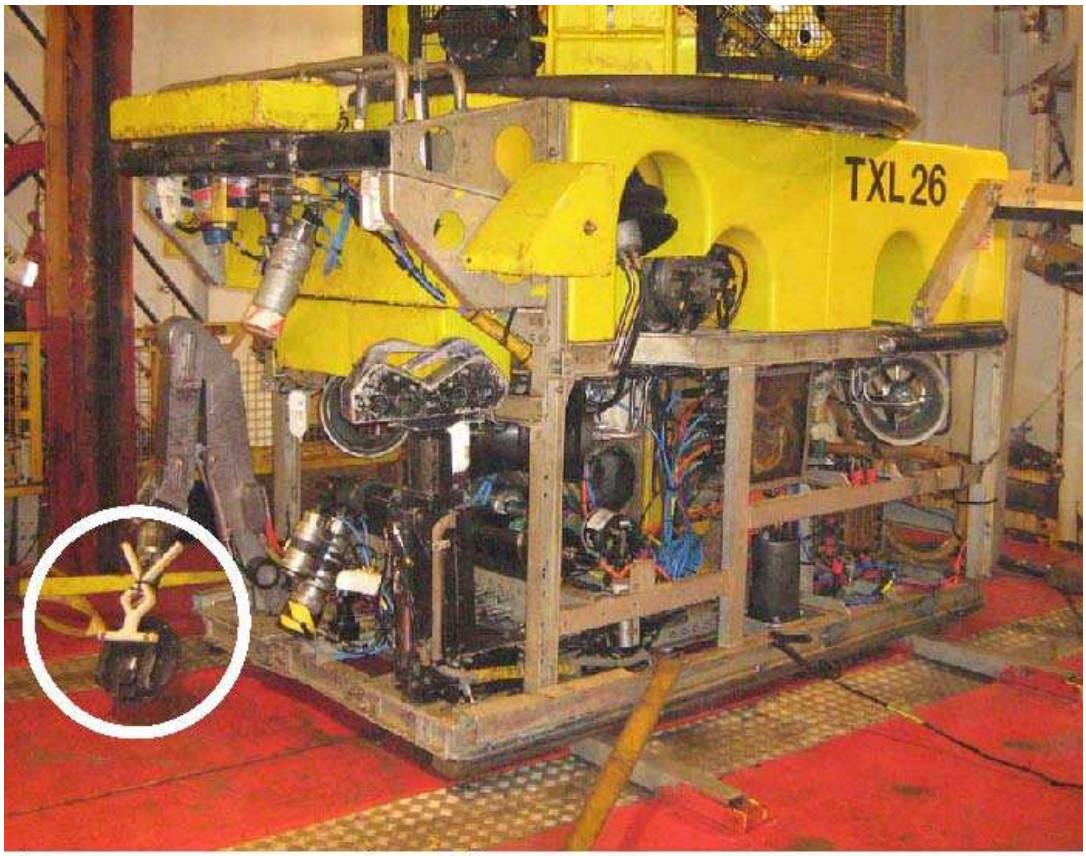


Fig. 12 RTD-INCOTEST Subsea probe on WORK CLASS RO

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